-8	0
-7	1
-6	2
-5	3
-4	4
-3	5
-2	6
-1	7
0	

0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9
1	0	1	0	10
1	0	1	1	11
1	1	0	0	12
1	1	0	1	13
1	1	1	0	14
1	1	1	1	15

+0	0	is cmpl	6
+1	1		1
2	2		2
3	3		
4	4		
5	5		5
6	6		6
7	7		7 →
-0	-7		-8
-1	-6		-7
-2	-5		-6
-3	-4		-5
-4	-3		-4
-5	-2		-3
-6	-1		-2
-7	-0		-1

Excess - 127

Encode (-5) + (8)

3

Decode:

1010 →

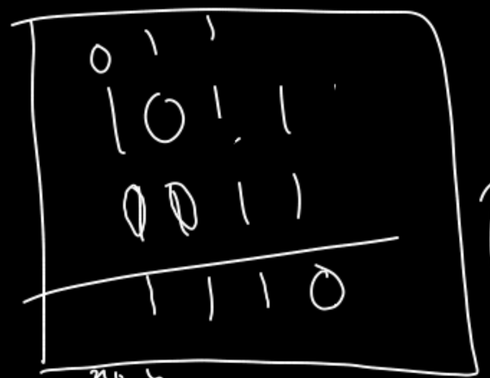
10 - 8

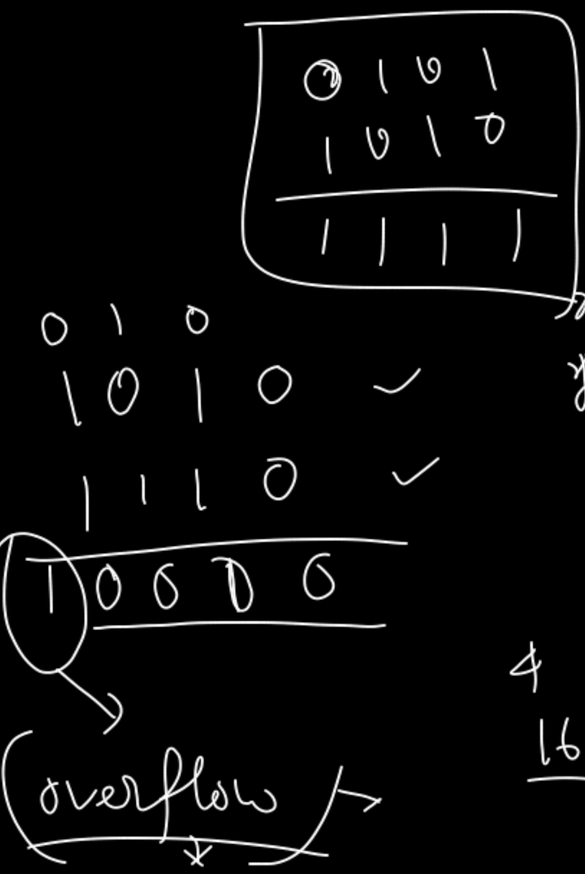
8 bits

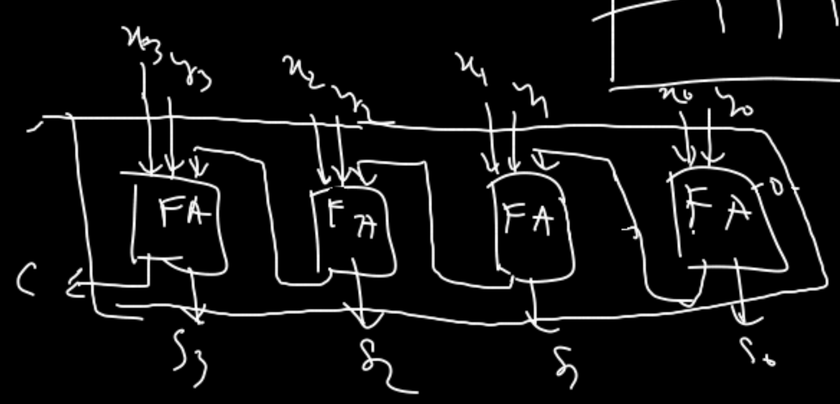
Addition

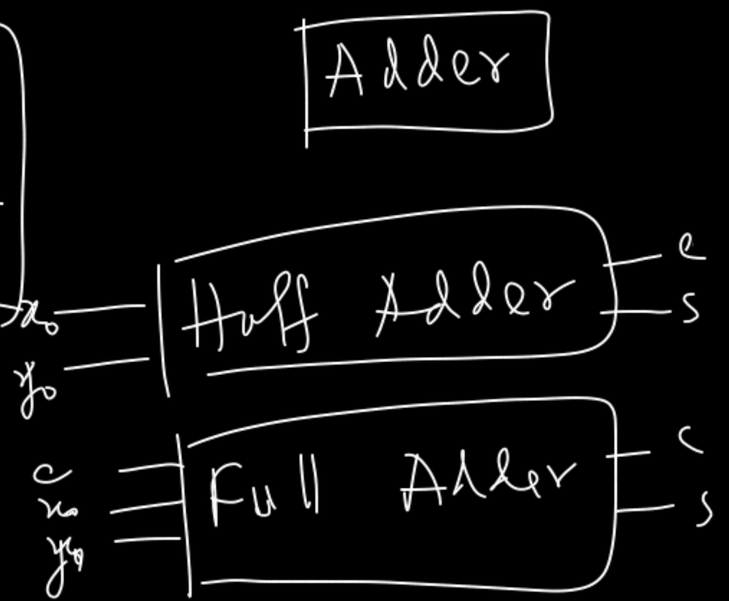
Unsigned version

① Regular Addition









$x_3 x_2 x_1 x_0$

$y_3 y_2 y_1 y_0$

$s_3 s_2 s_1 s_0$ c

4

16 ≤ 15

< 16

2^4

2' complement

Addition

```
   1 0 0
→  1 1 0 1 → -3
→  1 1 1 0 → -2
----------------
[1] 1 0 1 1   (-5)
```

```
  0 1 0 1
  0 0 1 0
----------
```

```
    1 1
  0 1 1 1   (7)
  0 1 0 1   (5)
----------
 (1) 1 0 0   (+4)
```

```
  1
  1 1 0 1   (-3)
  0 1 0 1   (5)
-----------
[1] 0 0 1 0   (+2)
```

How to detect Overflow?

8-bits

① Case 1 : (+ve) + (-ve)

$a \leq 127 \quad b \geq -128$

$a \leq 127$

$b \geq -128$

$-128 \leq a+b \leq 127$

Case 2: (+ve) + (+ve) changed MSB

Case 3: (-ve) + (-ve) change MSB

8 - bit

− 3
− 7

0 0 0 0 0 0 1 1

1 1 1 1 1 1 0 1 − 3

0 0 0 0 0 1 1 1

1 1 1 1 1 0 0 1 − 7

1 1 1 1 1 1 0 1

1 1 1 1 1 0 0 1

1 1 1 1 0 1 1 0 ✗

0 0 0 0 1 0 0 1

1 0 1 0 (− 10)